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(72) Inventors: KEITH GOSLING
MICHAEL ROSSON HYDE
BARRY GRAHAM PIKE

(54) ANTIPERSPIRANTS

(71) We, UNILEVER LIMITED, a British company, of Unilever House, Blackfriars, London EC4, England, do hereby declare the invention for which we pray that a patent may be granted to us and the method by which it is to be performed, to be particularly described in and by the following statement:

This invention relates to antiperspirant active agents.

For inhibiting perspiration, the application to the skin of many different antiperspirant active compounds has been described in the literature. However, those compounds most widely used in commercial products at the present time are basic aluminium halides, especially aluminium chlorhydrate, which has an Al/Cl molar ratio of about 2. These active compounds are applied to the skin from a variety of applicator types including aerosol sprays, pump sprays, squeeze packs, roll-ons and stick applicators. This aluminium chlorhydrate, for example, is employed as the active ingredient of various liquid, cream, stick or dry powder antiperspirant compositions. However, in spite of the popularity of aluminium chlorhydrate the presently available products are capable of producing only limited reduction in perspiration.

In Specification No. 1568831 (copending application No. 1401/76) there is described an improved antiperspirant active comound which comprises a basic aluminium chloride, bromide, iodide and nitrate having an aluminium to chloride, bromide, iodide or nitrate molar ratio of from 6.5 to 1.3:1, and which compound forms in water a solution containing polymeric species of a size greater than 100 Angstroms within which species there is contained at least 2% by weight of the total aluminium. Since in aqueous solutions of the basic aluminium compounds the halide or nitrate is in ionic form the polymeric species present are hydroxy-aluminium species. The antiperspirant active compound may be employed in the form of an aqueous solution or the solution may be spray dried to give a hydrated compound of the empirical formula

$$Al_2(OH)_{6-a}X_a.nH_2O$$

where

X is Cl, Br, I or NO_3

a is from about 0.3 to 1.5

n is from about 0.5 to 8.

As described in said copending application these special forms of basic aluminium compounds which in aqueous solution contain polymeric species having a size greater than 100 Angstroms within which at least 2% by weight of the total aluminium is contained, may be prepared by heating aqueous solutions of basic aluminium compounds at elevated temperature. The production of the desired species depends on the appropriate choice of the reaction conditions which are interrelated. It is preferred to use temperatures of from 80°C to 140°C. The period of heating may be shorter as higher temperatures are used, ranging for example from 0.5 hour to 30 days. Of importance is the concentration of the basic aluminium compound starting material. The rate of production of the higher polymeric species of the basic aluminium compound decreases as the concentration of the solution is increased and at the above temperatures the concentration should be no more than about 35% by weight.

The present invention relates to an improvement in the antiperspirant agents described in the said copending application.

According to the present invention there is provided an antiperspirant active agent comprising an aqueous solution of a basic aluminium chloride, bromide, iodide or nitrate having an aluminium to chloride, bromide, iodide or nitrate molar ratio of from 6.5 to 1.3:1 which solution contains species produced by said compound of a size greater than 100 Angstroms and within which species there is contained 2 to 80% by weight of the total aluminium, and which solution also contains a neutral amino acid.

By a neutral amino acid is meant an amino acid containing an equal number of unneutralised amino and acidic groups. Preferred amino acids contain 2 to 10 carbon atoms examples of which are glycine, sarcosine, alanine, phenylalanine, valine, leucine, methionine, taurine, ornithine monohydrochloride and glutamic acid monomethyl ester. By the addition of a neutral amino acid reduction of solution viscosity may be effected and gelling inhibited. The amino acid can also be used to increase the pH of the solution reducing any tendency of the solution to cause irritation of the skin or corrosion of metal containers in which it might be contained. In the case of powders obtained from these solutions the amino acid may act to inhibit corrosion of metal containers.

The amount of the amino acid is preferably such that the aluminium to amino acid molar ratio is from 20:1 to 1:1.

The basic aluminium compound preferably has an aluminium to chloride, bromide, iodide or nitrate molar ratio of from 4 to 1.3:1, more particularly 2.5 to 1.6:1.

The weight of the aluminium in the species having an effective diameter above 100 Angstroms is preferably 5 to 60% of the total aluminium.

The aqueous solution of the active antiperspirant agent comprising the higher polymeric species as defined, may, if desired, be evaporated to concentrate the solution or it may be dried to give a solid hydrated material. As with ordinary aluminium chlorhydrate, for example, drying conditions which lead to both the loss of water of condensation and hydrochloric acid should be avoided as these may lead to irreversible degradation of the basic aluminium compound. Any suitable method of drying may be used, spray drying being a particularly useful method. The spray drying method described in US Patent No. 3,887,692 may be employed. The solid material may be ground or milled as required, more particularly to a particle size below 100 microns such that the particulate compound is suitable for use in an aerosol powder spray product. Drying should be effected in such manner as to give a product having a water content consistent with the following empirical formula

$$Al_2(OH)_{6-a}X_a.nH_2O.\ (\text{Amino acid})_m$$

where X is Cl, Br, I or NO_3, a is from 0.3 to 1.5, n is from 0.5 to 8, preferably 0.5 to 4, and m indicates the amount of amino acid and is preferably 0.1 to 2.

The invention in another aspect relates to these novel solid antiperspirant active complex materials.

The powdered complex obtained on drying has superior characteristics, not possessed when the components are dried separately and combined in the dried state by simple physical mixing.

The compositions of the invention may be made by dissolving the amino acid in the solution of the basic aluminium compound containing the polymeric species greater than 100 Angstroms prepared as described in the above copending application. Alternatively the amino acid may be included in a solution made up from the powder obtained by drying the solution prepared according to the above copending application. The antiperspirant active agents of this invention may also be produced by the process of our concurrently filed application No. 17345/77. (Serial No. 1597498). This latter application relates to a process for producing an antiperspirant active material comprising heating an aqueous solution of a mixture of a basic aluminium chloride, bromide, iodide or nitrate having an aluminium to chloride, bromide, iodide or nitrate molar ratio of 6.5 to 1.3:1 and an amino acid, the concentration of the basic aluminium compound in such solution and the temperature and time of heating the solution being such that there is produced in the solution polymeric species having a size greater than 100 Angstroms, said species being produced in such amount that from 2 to 80% by weight of the total aluminium is contained within such species.

The antiperspirant agent of the invention may be employed directly as an antiperspirant composition in the form of the solution, or it may be used in antiperspirant compositions in the form of a powder obtained from such solution, or again as a solution obtained from such

powder. Various examples of suitable antiperspirant compositions are described in the copending application referred to above.

Thus in accordance with one aspect of the invention there is provided an antiperspirant composition comprising an aqueous solution of the basic aluminium compound and amino acid according to the invention in combination with an adjunct which is a perfume, thickener, alcohol or propellant. The antiperspirant composition may be in the form of a lotion comprising an aqueous or aqueous alcoholic solution of the basic aluminiu compound in a concentration of from 1 to 30% by weight and 0.1 to 5% by weight of a thickening agent. Suitable thickening agents for antiperspirant lotions are well known to those skilled in the art, and include for example, magnesium aluminium silicates. Thickening may also be effected by emulsifying an oil or the like in the composition. Furthermore, the composition may comprise an aqueous alcoholic solution of the basic aluminium compound in a concentration of from 1 to 30% by weight, the amino acid and from 0.1 to 2% by weight of perfume.

The composition may comprise an aqueous alcoholic solution of the basic aluminium compound and neutral amino acid containing up to 75% by weight of a C_1-C_3 aliphatic alcohol. These aqueous alcoholic compositions preferably contain ethanol, propanol, isopropanol or a mixture thereof as the alcohol. The amino acid is particularly useful with aqueous alcoholic solutions of the basic aluminium compound since such solutions have a greater propensity to gel than simple aqueous solutions. Antiperspirant compositions comprising an aqueous solution of the basic aluminium compound and the amino acid may contain from about 1 to 80% by weight of a propellant.

The antiperspirant composition may also comprise in combination a powdered antiperspirant active material obtained by drying the antiperspirant active solution of the invention and a powdered inert solid diluent or organic liquid carrier. The composition may be in the form of a powder aerosol composition comprising a suspension of the powdered basic aluminium compound/amino acid complex in a liquid carrier, said composition also comprising a propellant. In particular the composition may be in the form of a powder aerosol composition comprising

A. from about 1% to about 12% by weight of said basic aluminium compound/amino acid material in powder form;
B. from about 0.1% to about 5% by weight of a suspending agent;
C. from about 1% to about 15% by weight of a carrier liquid; and
D. from about 70% to about 96% by weight of a propellant.

The carrier liquid may for example be a non-volatile non-hygroscopic liquid as suggested in US Patent No. 3,968,203. Especially useful are carrier liquids which have emmollient properties and a number of these are referred to in British Patent Specification No. 1,393,860. Especially preferred are fatty acid esters such as isopropyl myristate and those esters referred to in British Patent Specification No. 1,353,914 such as dibutyl phthalate and diisopropyl adipate.

Various other carrier liquids for powder suspension aerosols are suggested in US Patent Specifications Nos. 3,833,721, 3,833,720, 3,920,807, 3,949,066 and 3,974,270 and in British Patent Specifications Nos. 1,341,748, 1,300,260, 1,369,872 and 1,411,547. Volatile carrier liquids may also be used such as ethanol or a volatile silicone as described in South African and British Patent Specifications Nos. 75/3576 and 1,467,676, respectively.

The ratio of total solids in the compositions to the carrier liquid may vary over a wide range, for example from 0.1 to 3 parts of the powder per part by weight of the carrier liquid.

The propellant can be a liquefied hydrocarbon, halogenated hydrocarbon or a mixture thereof. Examples of materials that are suitable for use as propellants are given in the above-mentioned patents and include trichlorofluoromethane, dichlorodifluoromethane, dichlorotetrafluoroethane, monochlorodifluoromethane, trichlorotrifluorethane, propane, butane, 1,1-diffluoroethane, 1,1-difluoro-1-chloroethane, dichloromonofluoromethane, methylene chloride, isopentane and isobutane, used singly or admixed. Trichlorofluoromethane, dichlorodifluoromethane, dichlorotetrafluoroethane, and isobutane, used singly or admixed. are preferred.

Examples of materials that are suitable for use as permanent gas propellants are nitrogen, carbon dioxide and nitrous oxide.

It is common practice to include in aerosol powder spray compositions a material to assist in the suspending of the powder in the liquid vehicle. The materials prevent compacting of the powder and they may also act as thickening or gelling agents for the liquid vehicle. Especially preferred are hydrophobic clays and colloidal silicas. Hydrophobic clays are available under the trade mark "Bentone", e.g. Bentone 34 or Bentone 38, and their use as suspending agents are described in a number of patent specifications including US Patent

Specification No. 3,773,683. Suitable colloidal silicas include Aerosil 200 and Cab-O-Sil M-5 as well as other grades; "Aerosil" and "Cab-O-Sil" are trade marks.

The antiperspirant composition may simply comprise from 5 to 40% by weight of the amino acid-containing aluminium compound in powder form, the remainder consisting essentially of an inert powder material, such as talc or starch, for example.

The invention also relates to packages consisting of the combination of an antiperspirant composition comprising an antiperspirant active agent according to the invention and an applicator for applying the antiperspirant composition to the skin. The package may be one in which the applicator is a container fitted with a valve for dispensing liquid in aerosol form and the antiperspirant composition comprises a suspension of the antiperspirant active agent in particulate form in a liquid carrier which may be in admixture with a propellant. Furthermore, the package may be one wherein the applicator is a container fitted with a valve for dispensing liquid in aerosol form and the antiperspirant composition comprises an aqueous or aqueous alcoholic solution of the basic aluminium compound and amino acid. In this case the aqueous solution may be discharged by a propellant gas or by a finger-operated pump mechanism or by containing the composition within a container of pliable material whereby by squeezing the container the composition is expelled through the spray valve. Another form of package is one in which the applicator is a roll-on applicator and the antiperspirant composition comprises an aqueous or aqueous alcoholic solution of the antiperspirant active material and amino acid. Furthermore, the package may be one wherein the applicator is an applicator for dispensing a powdered material and the antiperspirant composition is a powdered composition including the basic aluminium compound/amino acid complex in powder form. The applicator may also be a stick applicator for holding an antiperspirant composition in the form of a stick or it may be tissue or a cloth which is impregnated with the antiperspirant active material.

Determination of Percentage Aluminium in Polymeric Species having a size greater than 100 Angstroms

The heat treated basic aluminium compounds described herein were defined by molecular sieve chromatography. For this purpose there was used a 1.2 m × 6.0 mm column packed with spherical porous silica beads of particle size 75-125 microns, and of surface area 350-500 m^2/g, and having a maximum pore size of 100 Angstroms. The silica employed, available commercially as Porasil AX, has been deactivated to eliminate adsorption in molecular size separations. The use of Porasil silica beads as a column packing in chromatography is referred to in "Gel Permeation Chromatography" by K.H. Altgelt and L. Segan, 1971, pages 16 to 18. The silica was conditioned before use by passage of a single large sample (eg 0.5 ml of a 2% w/w solution) of a heat treated aluminium chlorhydrate. Samples to be tested were dissolved in deionized water to approximately 0.2 M aluminium and thoroughly dispersed by treatment (4 minutes) with a sonic probe. About 0.1 ml samples of approximately 0.2 M aluminium solutions were applied to the column by a sample loop system and eluted with 10^{-2} M aqueous hydrochloric acid solution using a peristaltic pump. A differential refractive index monitor linked to a pen recorder was used to detect fractions as they were eluted. These fractions were collected and analysed for aluminium by atomic absorption. Complete elution of all aluminium applied in each sample was checked by direct analysis of another sample of the same volume. The percentage of the total aluminium which appeared in the fraction eluted at the void volume of the column was considered as that deriving from polymeric material of a size greater than 100 Angstroms in effective diameter. None of this polymeric material was found in any untreated aluminium chlorhydrate solutions.

Determination of Water Content of Powdered Materials

The water content of powdered materials was estimated by thermogravimetric analysis (TGA). On heating to 1,000°C, aluminium chlorhydrate undergoes the following reaction:

$$Al_2(OH)_5Cl(H_2O)_x \longrightarrow Al_2O_3 + HCl\uparrow + (x + 2)H_2O\uparrow$$

From a knowledge of Al/Cl ratio of the material (and hence the empirical weight of the anhydrous $Al_2(OH)_{6-a}Cl_a$) it is possible to calculate the number of moles of water (x) associated with each anhydrous unit from an accurate determination of the weight loss on heating a known weight of sample to 1,000°C. The following equation shows the method of calculation:

$$x = \frac{\left(\frac{\text{Weight of solid before heating}}{\text{Weight of solid after heating}} \times 102\right) - \text{Empirical weight of anhydrous } [Al_2(OH)_{6-a}Cl_a]}{18}$$

The percentage of water is given by

$$\frac{1.800x}{\text{Empirical weight of anhydrous } Al_2(OH)_{6-a}Cl_a + 18x}$$

The following Examples illustrate the invention. Percentages are by weight.

Example 1

A batch of aluminium chlorhydrate having an Al/Cl molar ratio of 2.04 and a water content of 18.5% was dissolved in deionized water to give a 10% solution. This solution was heated in 1 litre screw cap glass bottles to 97-100°C over 10 hours and then held at this temperature for a further 38 hours. The resulting solution was cooled to room temperature and found to contain 23.9% of the total aluminium as polymers exceeding 100 Angstroms in effective diameter. This solution was then spray dried and the powder sieved to obtain the fraction between 30-50 microns, with a water content of 14.3%. A solution possessing antiperspirant properties was formulated containing 17.5% of the spray dried powder described above, and 5% glycine, the total being made up with deionized water. The glycine prevented gelation of the solution.

Examples 2 to 19

A number of aqueous alcoholic solutions of a neutral amino acid and the powder obtained as described in Example 1 were made up. They were prepared by mixing ethanol (30%) with the powder (15%) to form a slurry to which was added the neutral amino acid (5%) followed by the water which made up the balance of the composition. The neutral amino acids employed are given below.

Example	Neutral Amino Acid
2	Glycine
3	α-Alanine
4	β-Alanine
5	Taurine
6	Serine
7	Sarcosine
8	Valine
9	Leucine
10	Proline
11	Methionine
12	Threonine
13	Lysine monohydrochloride
14	Ornithine monohydrochloride
15	Glutamic acid γ-methyl ester
16	α-Amino-n-butyric acid
17	γ-Amino-n-butyric acid
18	5-Amino-caproic acid
19	ω-Amino-caprylic acid

In each case the neutral amino acid prevented gelation of the solution, effectiveness being independent of the isomeric form of the acids. When the amino acid was omitted gelation occurred on standing. Amino acids other than neutral amino acids failed to prevent gelation as shown by the use at the same level of lysine, arginine, aspartic acid and glutamic acid which were ineffective.

Examples 20 to 22

The following examples illustrate the use of neutral amino acids in solutions containing higher concentrations of ethanol. These solutions were prepared as before from ethanol, antiperspirant powder (15%) and neutral amino acid (5%) with water making up the balance. The concentrations of ethanol and the neutral amino acids employed are indicated below.

Example	% Ethanol	Neutral Amino Acid
20	40	Ornithine monohydrochloride
21	50	Leucine
22	60	Valine

In each case the neutral amino acid prevented gelation of the solution.

Example 23

70 kg of an aluminium chlorhydrate having an Al/Cl molar ratio of 1.91 and a water content of 18.8% was dissolved in 630 kg of deionized water at 45°C and stirred and heated to 120°C in a stainless steel reactor over 3.75 hours. Stirring and heating at this temperature was maintained for a further 5.5 hours before cooling rapidly to 70°C and more slowly to ambient temperature. The resulting solution contained 41.0% of the total aluminium as polymers with effective diameters exceeding 100 Angstroms. To a batch of this solution sufficient glycine was added to give a 7% glycine solution, with aluminium:glycine molar ratio of unity. The resultant solution was then spray dried using inlet and outlet temperatures of 250°C and 95°C, respectively. A 17.5% aqueous solution was made up from this powder and it did not gel. A 17.5% solution made up from powder prepared as above without the addition of the glycine did gel.

WHAT WE CLAIM IS:

1. An antiperspirant active agent comprising an aqueous solution of a basic aluminium chloride, bromide, iodide or nitrate having an aluminium to chloride, bromide, iodide or nitrate molar ratio of from 0.5 to 1.3:1 which solution contains polymeric species of a size greater than 100 Angstroms and within which species there is contained 2 to 80% by weight of the total aluminium, and which solution also contains a neutral amino acid.
2. An antiperspirant active agent as claimed in claim 1, wherein the amino acid contains 2 to 10 carbon atoms.
3. An antiperspirant active agent as claimed in claim 1, wherein the amino acid is glycine, sarcosine, alanine, phenylalanine, valine, leucine, methionine, taurine, ornithine monohydrochloride or glutamic acid monomethyl ester.
4. An antiperspirant active agent as claimed in any of the preceding claims, wherein the aluminium to amino acid molar ratio is from 20:1 to 1:1.
5. An antiperspirant active agent as claimed in any of the preceding claims, wherein the weight of the aluminium in the species having a size greater than 100 Angstroms is 5 to 60% of the total weight of the aluminium.
6. An antiperspirant active agent as claimed in any of the preceding claims additionally comprising a C_1-C_3 aliphatic alcohol.
7. An antiperspirant active agent in solid form obtained by drying the antiperspirant active solution claimed in any of claims 1 to 5, and having the empirical formula

$$Al_2(OH)_{6-a}X_a.nH_2O.(\text{Neutral amino acid})_m$$

where X is Cl, Br, I or NO_3, a is from 0.3 to 1.5, n is from 0.5 to 8, and m is from 0.1 to 2.
8. A solid antiperspirant active complex material having the empirical formula

$$Al_2(OH)_{6-a}X_a.nH_2O.(\text{Neutral amino acid})_m$$

where X is Cl, Br, I or NO_3, a is from 0.3 to 1.5, n is from 0.5 to 8, and m is from 0.1 to 2, said solid complex on dissolving in water forming species having a size greater than 100 Angstroms within which species there is contained 2 to 80% by weight of the total aluminium.
9. An antiperspirant composition comprising an antiperspirant active agent as claimed in any one of claims 1 to 5 in combination with an adjunct which is a perfume, thickener,

alcohol or propellant.

10. An antiperspirant composition comprising a solid complex antiperspirant active agent as claimed in claim 7 or 8 in combination with a powdered inert solid diluent or organic liquid carrier.

11. A package consisting of the combination of an antiperspirant composition as claimed in claim 9 or claim 10 and an applicator for applying the antiperspirant composition to the skin.

12. An antiperspirant active agent as claimed in claim 1 substantially as herein described with reference to any of the Examples.

13. An antiperspirant active agent as claimed in claim 7 substantially as herein described with reference to Example 23.

R.H. DOUCY
Chartered Patent Agent

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